Doc. Name: A:\AR95704

September 24, 1996

MEMORANDUM TO: PDIV-I File

FROM: Tom Alexion

SUBJECT: REMOVAL OF REACTOR VESSEL MISSILE SHIELDS AT ANO-1 (TAC NO. M95704)

On September 20, 1996, Bill Beckner and I gave general feedback to the licensee on the above subject as indicated in Attachment 1.

Attachment 2 is the licensee's 10 CFR 50.59 evaluation on the above subject.

Docket No. 50-313

Attachment: 1. Discussion Points with ANO
2. 10 CFR 50.59 Evaluation

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POINTS TO DISCUSS WITH ANO-1

REMOVAL OF REACTOR VESSEL MISSILE SHIELDS

1. The licensee is proceeding at their own risk. No NRC approval is expressed or implied.

2. The 50.59 for the reactor vessel missile shield removal refers to analyses performed by Framatome Technologies, but it doesn't reference which specific report by title, number, date, etc.

3. The B&W Owners Group report, titled "Reactor Vessel Missile Shield Removal Report," states that the reactor vessel head studs were shown not to be potential missiles. The report contradicts itself in that it also implies that these missiles are credible when it shows that these missiles will not reach the containment liner. The staff does not believe that vessel studs are credible missiles.

4. The NRC staff understands that the licensee did a 50.59 evaluation for heavy loads through their DCP that actually removes the shields from the reactor building. The staff assumes the licensee can do an adequate 50.59 for heavy loads.

ATTACHMENT 1

FOR INFORMATION ONLY

Document No. LDCR SAR Sect. 1.4.4, 3.2.4.3.2, 4.2.7, 5.2.1.4.8, & Table 5-2 Rev./Change No.

FINAL 50.59 RK

Title Reactor Vessel Missile Shield Removal

Will the proposed Activity:

1. Require a change to the Operating License including:

Technical Specifications (excluding the bases)?	Yes☐	No☒
Operating License?	Yes☐	No☒
Confirmatory Orders?	Yes☐	No☒

2. Result in information in the following SAR documents (including drawings and text) being (a) no longer true or accurate, or (b) violate a requirement stated in the document:

SAR (multi-volume set for each unit)?	Yes☒	No☐
QAMO?*	Yes☐	No☒
E-Plan?*	Yes☐	No☒
FHA	Yes☐	No☒
Bases of the Technical Specifications?	Yes☐	No☒
NRC Safety Evaluation Reports?	Yes☐	No☒

3. Involve a test or experiment not described in the SAR? Yes☐ No☒

4. Result in a potential impact to the environment? (Complete Environmental Impact Checklist of this form.) Yes☐ No☒

5. Result in the need for a Radiological Safety Evaluation per section 6.2.4.a? Yes☐ No☒

6. Result in the need for a 10CFR72.48 Review per section 6.2.4.b? Yes☐ No☒

Basis for Determination:

The purpose of this LDCR is to revise the ANO-1 SAR to remove the requirement for reactor vessel missile shields. Framatome Technologies recently completed analyses and investigations that support the permanent removal of the missile shields from the reactor building. Relying on past and current inspection practices, structural evaluations, and a failure modes and effects analysis of the control rod drive mechanisms (CRDMs), Framatome demonstrated that generation of a missile from a CRDM housing or other attachment to the reactor vessel head is not credible. Note that this LDCR only removes the requirement for the missile shields; another 50.59 determination will be completed with the DCP that actually removes the shields from the building.

* Changes to these documents require an evaluation in accordance with 10CFR50.54. See Section 6.2.1.B.

Document No. LDCR SAR Sect. 1.4.4, 3.2.4.3.2, 4.2.7, 5.2.1.4.8, & Table 5-2 Rev./Change No.

References: List sections reviewed in the Licensing Basis Documents, specified in questions 1, 2 and 3. If a keyword search was done on LRS, "all" may be entered under "Section" with the keyword(s) used in parentheses. Controlled hard copies of the documents shall be reviewed as computer-based searches such as LRS are not controlled and search text only, not figures or drawings. Attach a completed LDCR if LBD changes are required.

Document	Section
LRS/50.59-Unit 1 -SAR -Tech Specs -OL -QAMO -EPLAN -FHA -SER	All ("missile," "missiles," "shield," "shields," "nozzle and crack," "nozzle and cracking")

Daniel W. Fouts — Certified Reviewer's Signature

Daniel W. Fouts — Printed Name

2/28/96 — Date

Reviewer's certification expiration date: 5/18/96

Assistance provided by:

Printed Name	Scope of Assistance	Date

ENVIRONMENTAL IMPACT CHECKLIST
(UNIT 1 and UNIT 2)

Document No. LDCR SAR Sect. 1.4.4, 3.2.4.3.2, 4.2.7, 5.2.1.4.8, & Table 5-2 Rev./Change No.

Complete the following checklist. If the answer to any checklist item is "Yes", an Environmental Evaluation is required. See Section 6.2.1.E for additional guidance.

Will the Activity being evaluated:

Yes	No	
☐	☒	Disturb land that is beyond that initially disturbed during construction (i.e., new construction of buildings, creation or removal of ponds, or other terrestrial impact)? See Unit 2 SAR Figure 2.5-17. This applies only to areas outside the protected area.
☐	☒	Increase thermal discharges to lake or atmosphere?
☐	☒	Increase concentration of chemicals to cooling lake or atmosphere through discharge canal or tower?
☐	☒	Increase quantity of chemicals to cooling lake or atmosphere through discharge canal or tower?
☐	☒	Modify the design or operation of cooling tower which will change drift characteristics?
☐	☒	Install any new transmission lines leading offsite?
☐	☒	Change the design or operation of the intake or discharge structures?
☐	☒	Discharges any chemicals new or different from that previously discharged?
☐	☒	Potentially cause a spill or unevaluated discharge which may effect neighboring soils, surface water or ground water?
☐	☒	Involve burying or placement of any solid wastes in the site area which may effect runoff, surface water or ground water?
☐	☒	Involve incineration or disposal of any potentially hazardous materials on the ANO site?
☐	☒	Result in a change to nonradiological effluents or licensed reactor power level?
☐	☒	Potentially change the type or increase the amount of non-radiological air emissions from the ANO site.

Document No. LDCP SAR Sect. 1.4.4, 3.2.4.3.2, 4.2.7, 5.2.1.4.8, & Table 5-2 Rev./Change No.

10CFR50.59 Review Continuation Page

1. This change reflects the results of recent evaluations in which it was determined that the reactor vessel missile shields are not required for the health and safety of the public. The shields have been a part of the ANO-1 design in order to protect against a hypothetical missile being ejected from the reactor vessel head. It has now been shown that this previously hypothetical missile is not credible and need not be postulated. Neither the reactor vessel missile shields nor hypothetical missiles from the reactor vessel head were found to be within the scope of any Operating License documents (i.e., none of these documents require a change due to the deletion of the requirement for the shields).

2. A hypothetical missile being ejected from the reactor vessel head, and protection of the plant from this missile by the reactor vessel missile shields, are discussed in the ANO-1 SAR. No other SAR documents were found to provide the level of detail that the ANO-1 SAR provides. Based upon this finding, only the ANO-1 SAR contains information that is no longer accurate and should be revised.

3. This LDCR does not involve or affect any test or experiment. Therefore, implementation of the LDCR will not involve a test or experiment not described in the SAR.

4. Implementation of this LDCR will not result in a potential impact to the environment. See page 3 of this determination.

5. This LDCR does not involve the processing of radioactive material or create a pathway outside of monitored pathways. Thus, a Radiological Safety Evaluation is not needed.

6. This LDCR does not involve any potential impact upon the spent fuel Ventilated Storage Cask. Therefore, a 10CFR72.48 review is not required.

10CFR50.59 Eval. No. EEN-96-035
(Assigned by PSC)

Document No. LDCR SAR Sect. 1.4.4, 3.2.4.3.2, 4.2.7, 5.2.1.4.6, & Table 5-2 Rev./Change No.

Title Reactor Vessel Missile Shield Removal

A WRITTEN RESPONSE PROVIDING THE BASIS FOR THE ANSWER TO EACH QUESTION MUST BE ATTACHED. EACH QUESTION MUST BE ANSWERED SEPARATELY. A SIMPLE STATEMENT OF CONCLUSION IS NOT SUFFICIENT. ATTACHMENT 2 PROVIDES GUIDANCE FOR RESPONSE.

If the answer to any question on this form is "Yes," then an unreviewed safety question is involved. If the answer to all questions is "No," then the proposed change does not involve an unreviewed safety question.

1. Will the probability of an accident previously evaluated in the SAR be increased? Yes ☐ No ☒

   See attached writeup.

2. Will the consequences of an accident previously evaluated in the SAR be increased? Yes ☐ No ☒

   See attached writeup.

3. Will the probability of a malfunction of equipment important to safety be increased? Yes ☐ No ☒

   See attached writeup.

4. Will the consequences of a malfunction of equipment important to safety be increased? Yes ☐ No ☒

   See attached writeup.

5. Will the possibility of an accident of a different type than any previously evaluated in the SAR be created? Yes ☐ No ☒

   See attached writeup.

6. Will the possibility of a malfunction of equipment important to safety of a different type than any previously evaluated in the SAR be created? Yes ☐ No ☒

   See attached writeup.

7. Will the margin of safety as defined in the bases for any technical specification be reduced? Yes ☐ No ☒

   See attached writeup.

Document No. LDCR SAR Sect. 1.4.4, 3.2.4.3.2, 4.2.7, 5.2.1.4.8, & Table 5-2 Rev./Change No.

Daniel W. Fouts — Daniel W. Fouts — 3/6/96

Certified Reviewer's Signature / Printed Name / Date

Reviewer's certification expiration date: 5/18/96

Assistance provided by:

Printed Name	Scope of Assistance	Date
S. A. Bennett	Reviewed and commented on document prior to PSC submittal.	3/6/96

PSC review by: John A Selva Date: 4-9-96

Document No. LDCR SAR Sect. 1.4.4, 3.2.4.3.2, 4.2.7, 5.2.1.4.8, & Table 5-2 Rev./Change No.

10CFR50.59 Review Continuation Page

The purpose of this change is to remove the requirement for the reactor vessel missile shields inside the ANO-1 reactor building. The ANO-1 SAR lists potential missiles in Table 5-2. Among the list of potential missiles is an entire control rod drive mechanism (CRDM) assembly. An analysis of the credibility of this potential missile was not previously performed. Rather, reactor vessel missile shields were simply designed and installed to protect the plant against this assumed potential missile. Since the initial design, construction and licensing of ANO-1, tools and techniques have been developed to evaluate the credibility of this hypothetical missile. Extensive analyses have now been performed by Framatome Technologies and these analyses show that generation of a missile from a CRDM housing or other attachment to the reactor vessel head is not credible. Since the NRC's Standard Review Plan (SRP) only requires consideration and protection from credible missiles, the reactor vessel missile shields are no longer required. This conclusion is consistent with earlier findings that no additional protection against potential missiles is required because they are "non-credible" missiles (e.g., RCP motor flywheels). The B&W Owners Group summary report, which concludes that generation of a missile from a CRDM housing or other attachment to the reactor vessel head is not credible and includes a Failures Modes and Effects Analysis (FMEA), is attached to and a part of this 10CFR50.59 safety evaluation.

In addition to evaluating the credibility of a missile being generated from a CRDM housing or other attachment to the reactor vessel head, the design and operation of ANO-1 were reviewed for other impacts that removal of the missile shields might have. The following additional areas were then considered:

a) the reactor building response to the design basis accident due to decreased heat sink surface area and increased reactor building volume;

b) the change to the seismic response of the reactor building;

c) the effect of direct spray on equipment previously covered by the missile shields post-accident;

d) the impact on severe accident analyses;

e) the elimination of a periodic heavy load movement; and

f) the changes to reactor building cooling during normal operation.

None of these issues were found to significantly impact ANO-1 in an adverse manner. In fact, several of the issues are positively impacted by the removal of the missile shields, such that the net impact on ANO-1 safety is likely positive. With the exception of the severe accident analyses, each of the issues is further discussed in response to the questions below. With respect to the severe accident analyses, the reactor vessel missile shields have never been credited for mitigation of the postulated severe accident events at ANO-1.

Document No. LDCR SAR Sect. 1.4.4, 3.2.4.3.2, 4.2.7, 5.2.1.4.8, & Table 5-2 Rev./Change No.

1. Will the probability of an accident previously evaluated in the SAR be increased?

The reactor vessel missile shields are not associated with the initiation of any accident. Further, this change does not involve any new plant operating conditions that might result in initiation of an accident. On the contrary, removal of the reactor vessel missile shields could reduce the probability of an accident by removing the need to repeatedly move these heavy loads above the reactor vessel. No other secondary effects of the missile shield removal were found to be potentially associated with accident initiation.Thus, the probability of an accident previously evaluated in the SAR will not be increased.

2. Will the consequences of an accident previously evaluated in the SAR be increased?

No accident analyses previously evaluated in the SAR (Chapters 6 and 14) directly rely on the missile shields for mitigation. However, two accidents, the large break LOCA and Containment DBA, utilize as inputs the net free volume and heat sink surface areas in the reactor building. For both inputs in both analyses, conservative assumptions, rather than actual values, have been input in the past. With respect to the large break LOCA, total free volume and surface area assumptions only are input. These assumptions remain very conservative with the missile shields removed. For the Containment DBA, an increase in the net free volume, as would occur with missile shield removal from the building, is always conservative. A review of the assumed total surface area for this event indicates that it will remain conservative with the missile shields removed. The total surface area for the Containment DBA is also subdivided into the types of heat sinks present. The actual amount of unlined concrete surface area will be reduced slightly with missile shield removal, but the analysis assumptions with respect to uninsulated steel and total heat sink surface area are so conservative that the peak post-accident reactor building pressure and temperature will remain conservative and the long-term DBA results will be essentially unaffected. Thus, no changes to assumed post-accident radioactive releases will occur.

Another area of potential concern is the consequence of a seismic event with the missile shields removed. This concern was addressed by the Framatome analyses which focused on changes to the natural frequency of the reactor building internal structures. The results of those evaluations showed an insignificant increase in response acceleration.

Removal of the missile shields will also result in direct impingement of reactor building spray upon components previously covered post-accident. SAR Section 6.6.1 identifies sources of hydrogen generation inside the reactor building. Although being sealed or otherwise protected from the building spray is a criterion for assuming that no reaction will occur, the missile shields were not credited for this

protection. In fact, CRD parts are explicitly identified as sources of hydrogen generation due to being completely exposed to the spray. The review of the ANO-1 LBDs did not identify any other post-accident areas of concern or evaluations of equipment beneath the missile shields which would now be exposed to the spray.

From the above results, it is concluded that no changes to the calculated offsite and control room doses will result from removal of the missile shields and therefore the consequences of an accident previously evaluated in the SAR will not be increased.

3. Will the probability of a malfunction of equipment important to safety be increased?

The reactor vessel missile shields were designed to mitigate the consequences of a potential CRDM assembly ejection. They do not interface with the CRDMs during normal plant operation and as such their removal will not affect the probability of a malfunction of that equipment. A review of the failure modes identified and evaluated by Framatome in their analysis (summary attached) does not indicate that any of the modes are dependent on the missile shield status or that the effects of CRDM failure on other equipment important to safety require the missile shields for mitigation. Likewise, this change does not impact any other equipment important to safety, i.e., the failure modes of other equipment important to safety are not dependent on missile shield status. Although there have been no problems with cooling of equipment beneath the missile shields, removal of the shields will create direct communication between the area above the reactor vessel and the open upper elevations of the reactor building. This communication will allow greater air flows and will likely lower the temperature directly above the reactor vessel head during normal operation. Thus, the reliability of equipment important to safety may actually increase due to a lower temperature in that area and the consequential reduction in degradation (aging) rates. Therefore, the probability of a malfunction of equipment important to safety will not be increased.

4. Will the consequences of a malfunction of equipment important to safety be increased?

The only purpose of the reactor vessel missile shields was to mitigate the consequences of a potential CRDM assembly ejection. This "missile" has now been shown to not be credible, such that missile protection is not required. Thus, the result of a malfunction of this equipment will be reactor coolant leakage or blowdown without missile generation and this result will be the same with and without the missile shields. No other malfunctions of equipment important to safety were found to be potentially mitigated by the missile shields. As stated above, a review of the failure modes identified and evaluated by Framatome in their analysis indicates that the failure modes of the CRDMs do not rely on the missile

shields to protect other equipment important to safety. Since no additional missiles are generated and the previously postulated CRDM missiles are not credible, the dose consequences of a malfunction of equipment important to safety will not be increased.

5. Will the possibility of an accident of a different type than any previously evaluated in the SAR be created?

   This change does not introduce any new or different plant operating conditions or failure modes. The only effects of opening the area above the reactor vessel to the upper elevations of the reactor building were identified in the opening paragraghs of this evaluation; none of those effects create a new type of accident. Therefore, the possibility of an accident of a different type than any previously evaluated in the SAR will not be created.

6. Will the possibility of a malfunction of equipment important to safety of a different type than previously evaluated in the SAR be created?

   This change does not require any changes to existing plant equipment, does not require any new equipment, and does not produce any new or different operating conditions. Additionally, the Framatome failure modes and effects analysis does not identify any different types of malfunctions of equipment important to safety than any previously evaluated. Thus, this change will not create the possibility of a malfunction of equipment important to safety of a different type than any previously evaluated in the SAR.

7. Will the margin of safety as defined in the bases for any technical specification be reduced?

   The reactor vessel missile shields, and the protection that they potentially provided, are not explicitly or implicitly defined or addressed in the bases of the ANO-1 Technical Specifications. Therefore, the margin of safety as defined in the bases for any technical specification will not be reduced.